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THE THUNDERBIRD TSY 255 SWING YARDER

Rob Prebble

ABSTRACT

A Thunderbird TSY 255 swing yarder was studied working in a stand of 80 year old Douglas fir mixed with other minor species in Oregon, USA. Extraction was in log length and the average piece size of the logs was 1.05m³. The machine was rigged as a running skyline with a Mechanical Slack Pulling (MSP) carriage.

Productivity was estimated at around 280m³ per eight hour shift. Limitations on loader capacity and longer than usual rigging delays lowered overall productivity.

Close to 65% of the drags were pre-stropped during the study and this method of hooking on was 24% quicker per piece than using attached strops. Overall however, there was no significant difference in cycle times. Average hook on times were fast at .64 minutes for 3.9 pieces but usually there were four and sometimes five breaking out.

With an operation like the Thunderbird TSY 255 expected to cost over $4100 per day in New Zealand, there is no margin for error in daily productivity calculations on which targets may be set. Careful planning of the whole system from felling to transportation will be necessary for it to be economically viable.

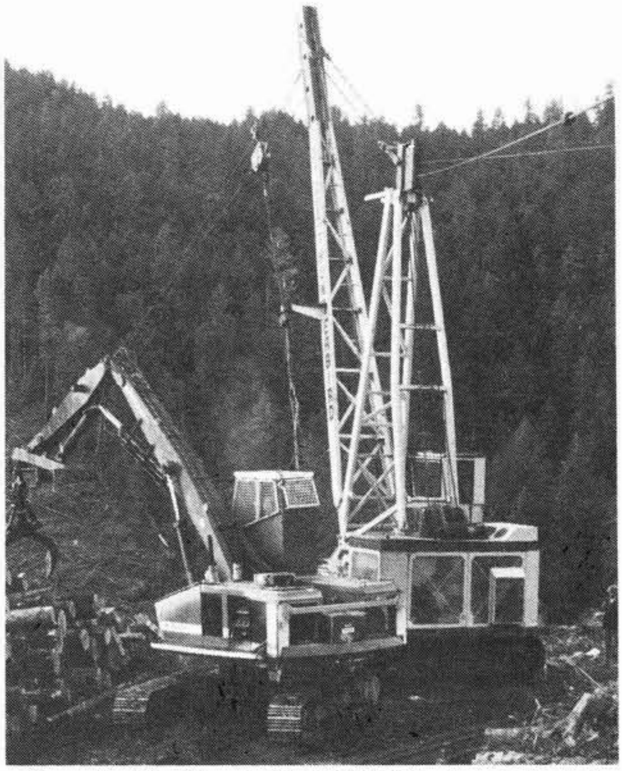

Figure 1 : The Thunderbird TSY 255 swing yarder and Koehring 366L loader

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INTRODUCTION

The Thunderbird brand of haulers, manufactured by Ross Equipment in Oregon, are relatively new machines on the market compared to Madill, Skagit, Berger etc. In Oregon and Washington they have proved strong competitition for the older, more established brands taking a major share of the skyline hauler sales and more recently they have made inroads in the swing yarder market.

Swing yarders are generally track mounted which enables them to negotiate low quality roads and travel over difficult ground conditions. The swing facility allows the machine to operate over the side of its undercarriage and to land logs on the same road or track that it is working from. A machine shift therefore, involves simply releasing the guylines and walking along to the next location. Landing construction can be reduced to a minimum with this method of logging.

A feature of most swing yarders manufactured these days is interlocking between the tailrope and mainrope drums. Interlocking regenerates energy, normally lost through braking, back into the input drive which improves efficiency and operator control. Some machines have interlocking in both directions, i.e. outhaul and inhaul and while this is good for grapple yarding, it is not really necessary for MSP[1] carriage systems. The main reasons for this are that interlock loses efficiency over long outhaul distances and the slipping clutch mechanism adds to the cost of the machine.

Thunderbird have basically been producing machines for the Oregon and Californian markets and loggers there have a preference for MSP carriage operation. MSP systems tend to be more efficient than grapples over longer hauling distances and they are less sensitive to areas with low volumes per hectare.

The TSY 255 Thunderbird has been designed for MSP operation and as such only has interlock on the inhaul. It has greater line capacities and line pulls than its closest competitor, the Madill 122 (Prebble, 1989a) but line speeds are slower and the operator has to keep more brake pressure on the mainrope during outhaul when grapple yarding. Competition between these two manufacturers appears to be intense with each new model having added features over its predecessor and more importantly over the latest machine from the opposition. Whether this prestige war actually benefits the logger remains to be seen as with each new development comes an increase in price.

While the potential for swing yarders in New Zealand may not be great, there are places where they will work well and could be cost competitive with other systems. Environmentally sensitive areas with unstable ground conditions or high road and landing construction costs are examples of where a swing yarder system could be used.

A previous study of a high cost swing yarder operation in New Zealand (Prebble, 1988) indicated that the machine had fast cycle times but average drag size was well below the optimum payload and as a result, logging costs were high. With the even higher cost of machines like the TSY 255 Thunderbird, low utilisation and small payloads could not be tolerated.

As part of a series of machine studies a Thunderbird TSY 255 swing yarder working in the Roseburg area was production studied in December, 1988. This report presents the results from that study.

THE MACHINE

The Thunderbird TSY 255 can be mounted on a rubber-tyred carrier, but most machines are track mounted. Basic specifications are:

Engine	- *313 kw Detroit Diesel 8V92T*
Transmission	- *Twin Disc, 5 speed forwards, 1 reverse*
Undercarriage	- *Track mount, hydrostatic drive capable of speeds up to 6 kph*
Gradeability	- *up to 50%*
Tower	- *lattice steel construction*
Working height fairlead	*to top of tailrope* - *15.1m*

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[1]*Mechanical Slack Pulling*

Drum Capacities and Performance

Drum	Rope Size (mm)	Operating Capacity	Mid drum linepull* (kg)	Mid drum linespeed** (m/min)
Mainrope	22	610	30,872	671
Slackpuller	22	610	30,872	671
Tailrope	22	1220	27,830	732
Strawline	10	1403	-	-
Guylines (3)	28	38	-	-

*At stall
**In a no load situation

Clutches and Brakes

Drum	Clutch	Interlock	Brake
Mainrope	24x5 Internal expanding	-	Eaton WCB 218 36x2 1/2 Band
Slackpuller	24x5 Internal expanding	-	Eaton WCB 218 36x2 1/2 Band
Tailrope	24x5 Internal expanding	Eaton WCB-224	Two 36x3 Bands
Strawline	Disc clutch	-	-

Operating weight - 52,210 kg
Length - 5.8m, carrier only, with tower lowered 16.5m
Price as at December, 1988 - US$555,000

LOGGING SYSTEM

The TSY 255 was working in a stand of 80 year old Douglas Fir (90%), with minor species of incense cedar, ponderosa pine and white fir (10%). It was set up in a running skyline system with a Danebo MSP carriage and four 7.5 m long strops on the dropline. Extraction was in log length with the felling and processing being done by contract fallers. Six log sorts had been cut with five main segregations and one minor one. Average log size was 1.05m^3.

Two landing locations were used during this study, the first was simply a road edge with the chute area on the cutover below the road and the second was on a turnout which allowed more room to land the logs. On the first landing most logs were stockpiled on the cutover (about a 20% slope).

The original loader in this operation was a track mounted Koehring 366L with a live heel but partway through the study it was taken out of service for mechanical repairs and replaced with a Prentice 600B mounted on a Pierce rubber-tyred carrier. Being rubber mounted restricted where the Prentice could be located and this affected its ability to handle the wood in the chute.

Figure 2 : Logs were landed in the chute area on the cutover of landing 1.

A team of four were breaking out for most of the time but occasionally the hook tender (crew boss) assisted. Nearly 65% of the drags were prestropped. Only logs lying directly under the rigging or very close to the landing were not pre-stropped. Two chasers were unhooking at the landing, but one of them was actually attached to the skidder operation working adjacent to the swing yarder.

STUDY METHOD

Productivity data was collected over 70 cycles using the continuous time study technique. Haul distances were recorded off a ground profile taken prior to the study commencing (see Figure 3). The volume per piece was determined by converting actual scaled board-foot piece size to metric volume per truckload and relating that to the number of pieces per load. The two chasers and the loader in service at the time were activity sampled concurrent with the hauler study and are reported separately (Prebble 1989b).

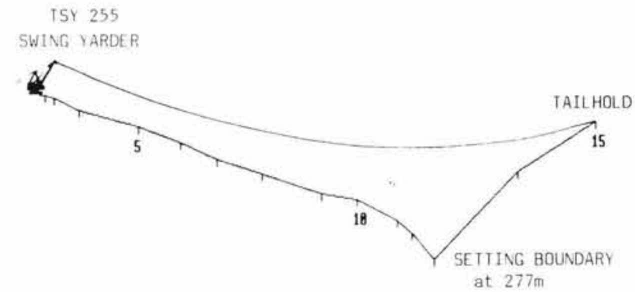

Figure 3 : A typical ground profile of the logging area.

RESULTS

Average cycle times from the study data are shown in Table 1. For over 63% of the time, four breaker-outs were hooking on but there were periods when both three and five breaker-outs were used, (16 and 21% respectively).

Outhaul and inhaul times have been standardised to a common 200m distance by the equations:

$$Out = .099 + .0023\ (dist),\ r^2 = .72$$
$$Inh = .208 + .0042\ (dist),\ r^2 = .62$$

Actual haul distances during the study were short (range 20-110m) and as such predicted outhaul and inhaul times may be slower than what could be achieved. The time taken to land the logs at the landing, was considerably longer when the Prentice 600B was in operation. Each drag had to be pulled in closer and swung around further to enable the Prentice to reach the logs in the chute.

Even with the slower outhaul and inhaul times and the longer than usual lower rigging time, hourly productivity was still high at $37m^3$. The average hook on time per piece was very quick at .16 min and this contributed to the relatively fast cycle times. Hook on during pre-stropping was 24% faster per piece than when using attached strops but overall there was no significant difference in cycle times.

Table 1 : Average Cycle Times for Thunderbird TSY 255

Element	Time, mins
Sample size	70
Raise rigging	.45
Outhaul	.56 (200m)
Position[(1)]	.61
Lateral out	.21 (6.7m)
Hook on	.64 (3.89 pcs)
Breakout	.36
Inhaul	1.05 (200m)
Lower rigging	.33
Unhook	.56
Delay free total	4.77 (SD = .54)
Production delays	.04
Landing delays	.09
Rigging	.86
Other	.86
Total cycle time	6.62
Pieces/cycle	3.89
Ave piece size	1.05m^3
Ave drag size	4.08m^3
Production per available machine hour	37m^3 (35 pieces)

[(1)]Position includes sorting strops
SD = Standard Deviation

The average drag size of 4.08m^3 was around the optimum for this machine and was very similar to the average drag for the Madill 122 (Prebble, 1989a). Delay free cycle times were actually quicker in the TSY 255 study but there was little difference in total cycle times.

The lineshift time was longer than usual in the TSY 255 operation and this was mainly due to the nature of the profile (see Figure 3). The belly in the tailrope crossing the gully made it difficult for the hook tender to get enough slack to trip the block. A 33 minute machine shift was also recorded and this would be a common occurrence with the logging system being used i.e. no landing formation and frequent machine shifts along the road.

In short studies such as this, no measure can be taken of long term machine availability. Long term data collected on a Washington 88 (Prebble, 1988) indicated that availability levels of around 95% could be expected. At this level, productivity of the TSY 255 would be approximately 280m^3 per eight hour shift. Machine utilisation in this study was 69%.

COSTS

Using the LIRA costing format (Wells, 1981) it would cost about $4,100 per day to run a new TSY 255, a 30 tonne loader and ten men (see Table 2). At a production of 280m^3/day the unit cost would be $14.75/m^3.

Table 2 : Indicative Costings, TSY 255 Operation

Cost Centre	Cost ($NZ)
Hauler	1395
Loader	525
Labour (10 men)	1530
Operating supplies	230
Overheads	75
Profit (10%)	375
Total	$4130

DISCUSSION

Production from the Thunderbird TSY 255 was not as high as could be expected from this type of machine working in 1.05m^3 average piece size. While delay free cycles were relatively quick, time lost to rigging delays and other delays reduced overall productivity. Inhaul and lower rigging times were slowed when the Prentice 600B loader was in service.

Average hook on time was fast at .16 min per piece. The two main reasons for this were: having four and sometimes five breaking out, and, the fact that nearly 65% of the logs were pre-stropped. Pre-stropping reduced hook on time by 24% but it was only feasible when the breaker-outs were more than 50m away from the hauler, and when logs were not directly under the ropes.

Frequent machine shifts are a feature of a swing yarding system where little or no landing formation is done. In this study it took 33 minutes to move the hauler about 50 - 60m along the road to the next landing location. The lineshifts took longer than usual because of the nature of the profile being logged.

As noted in the Madill 122 report, some form of mechanisation or two staging system may be necessary for the TSY 255 to be successful in New Zealand operations. With a daily cost in excess of $4100, there is no room for low productivity or lengthy landing delays. Planning for such an operation should take full advantage of the manoeuvrability and flexibility of the swing yarder. Most importantly there must be plenty of wood on the ground in front of it to pull, and no hold-ups at the landing or in the transport system.

To remain competitive with the new Madill 123 (Prebble, 1989a), Thunderbird now produce a TSY 355 swing yarder which has greater line pulls and line speeds, increased rope capacity (up to 700m of mainrope and 1400 of tailrope), interlock on both outhaul and inhaul and a live 18m boom. Naturally the price is higher too at around US$595,000. Thunderbird have designed this machine for grapple yarding and are aiming it at the Canadian market.

REFERENCES

PREBBLE, R.L. (1988) : "A Study of Log Length and Tree Length Extraction using a Washington 88 Hauler". LIRA Project Report P.R. 34.

PREBBLE, R.L. (1989a) : "Madill 122 Interlock Swing Yarder". LIRA Brief Report Vol. 14 No. 18.

PREBBLE, R.L. (1989b) : "A Study of Landing Activities in PNW Swing Yarder Operations". LIRA Brief Report Vol. 14 (in prep.)

WELLS, G.L. (1981) : "Costing Handbook for Logging Contractors". LIRA.

The costs stated in this Report have been derived using the procedure shown in the LIRA Costing Handbook. They are only an indicative estimate and do not necessarily represent the actual costs for this operation.

For further information, contact:

N.Z. LOGGING INDUSTRY RESEARCH ASSOC. INC.
P.O. Box 147,
ROTORUA, NEW ZEALAND.
Fax: (073) 462-886 Telephone (073) 487-168